CLAIMS:

1.   An image processing method of extracting geometrical data of the spine, for extracting the left and right pedicle landmarks of each spine vertebra, comprising steps of:

          acquiring image data of a 2-D frontal image of the spine; associating spine States to vertebra positions along the spine and estimating locations of left and right pedicle landmark

5   Candidates (P_L and P_R) in each State (V);

          defining a State Cost for forming Couples of left and right pedicle landmark Candidates;

          estimating sets of Best Couple Candidates, in each State, from the lowest State Costs;

          defining a Path Cost to go from one State to the next State;

10   selecting a pedicle landmark Couple in each spine State among the Best Couple Candidates from the minimum Path Costs, and localizing the left and right pedicle landmarks of each spine vertebra from said selected pedicle landmark Couple.

2.   The image processing method of Claim 1, wherein the step of selecting said

15   pedicle landmark Couple comprises:

          defining a 3-D Cost Matrix having planes, defining Bands corresponding to the States, in which the Best Couple Candidates are located, said Cost Matrix having a directional axis, orthogonal to said planes, for indices corresponding to spine States;

          performing a first pass in a first direction along said directional axis, for computing

20   the Path Costs between the Best Couple Candidates of each State and the Best Couple Candidates of the corresponding Predecessor State, and performing a second pass in the reverse direction for selecting a Couple in each State that show the lowest Path Cost to go to the next State.

25   3.   The image processing method of Claim 2, wherein the Path Cost definition comprises compounding Local Costs related to the landmark location Candidates in the predecessor State, the State Cost for forming Couple Candidates in the current State and a Transition Cost that is function of the Distance between the Couple Candidates in each State,

which penalizes sudden local variation of the rotational angle of the vertebrae of the predecessor and current State.

4.   The image processing method of Claim 3, wherein the State Cost definition comprises summing respective Local Costs for left and right pedicle landmark location Candidates, and a normalized Distance between said left and right pedicle landmark candidate locations in each State, which takes the index of the State into account.

5.   The image processing method of one of Claims 1 to 4, wherein the estimation of left and right pedicle landmark location Candidates in each State comprises:

computing, from the spine image data, Features Values that are characteristic of thin structures;

scanning a region, called Region of Scanning, containing the pedicles, for each vertebra, along scan lines substantially parallel to the pedicle internal border lines, where the pedicle landmarks are to be localized; andaccumulating Feature Values of each scan line on an axis, called X-axis that is orthogonal to the scan lines, and transforming the accumulated Feature Values into Costs, called Local Costs, measured along said X- axis, said Local Cost Values being the smallest for the highest Accumulated Values;

performing a search for the left and right pedicle landmark location Candidates among the points of said X-axis associated to the smallest Local Costs.

6.   The image processing method of Claim 5, wherein the determination of the Best Couple Candidates, at a given State, comprises:

determining a range for the left pedicle landmark location Candidates on the X-axis;

determining a number of location Candidates for the right pedicle landmarks, in a Search Region determined on said X-axis at a predetermined Distance of the current left pedicle location Candidate;

dividing said Search Region into a number of bins, each containing a number of right pedicle landmark location Candidates; computing the State Cost and selecting sets of Best Couple Candidates linked by the smallest State Costs.

7.   The image processing method of one of Claims 5 or 6, wherein the determination of the Region of Scanning comprises:

selecting an image of a current vertebra delimited by lines joining its corner landmarks;

estimating the median axis of the vertebra sides and the angle between said axis and a reference horizontal axis of the 2-D spine frontal image;

5   rotating the image of said current vertebra by said angle and defining an horizontal axis, which is the X-axis corresponding to said current vertebra; and limiting the rotated image by the leftmost and the rightmost projections of the vertebra corner landmarks on said X-axis, thus defining a rectangular image region used as Region of Scanning.

10   8.   The image processing method of one of Claims 5 to 7, wherein the Feature Values are the ridgeness values estimated in the Region of Scanning.

9.   A system comprising a suitably programmed computer or a special purpose processor having circuit means, which are arranged to process image data according to the

15   method as claimed in any one of the preceding Claims.

10.   A medical examination imaging apparatus having means for acquiring medical digital image data and having a system having access to said medical digital image data according to Claim 9, and having display means for displaying the medical digital images

20   and the processed medical digital images.

11.   A computer program product comprising a set of instructions for carrying out a method as claimed in one of Claims 1 to 8.